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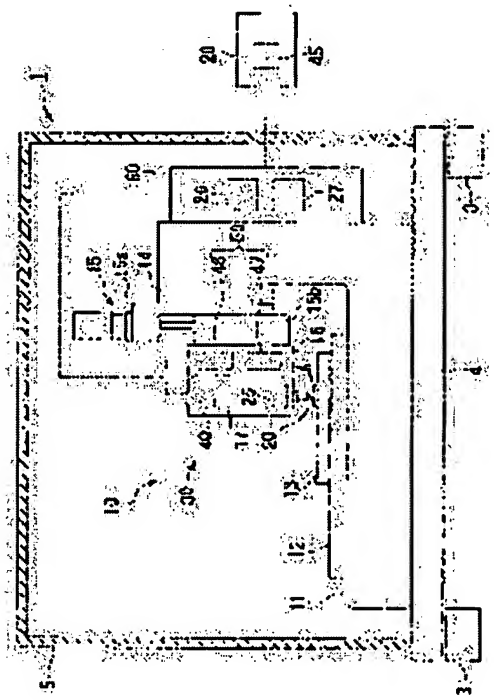
(54) PROBE MICROSCOPE

(57)Abstract:

PROBLEM TO BE SOLVED: To attain thermal stability to reduce temperature drift of data.

SOLUTION: This probe microscope 1 for measuring a surface shape or a physical quantity of a measured object A is provided with a measuring mechanism 30 for conducting the measurement under the condition where a probe in a tip of a cantilever 20 is approached or brought into contact with a surface of the measured object A, a temperature sensor 40 for measuring a temperature of the measuring mechanism 30 or the periphery thereof, a heating and cooling mechanism 50 for executing either of heating or cooling for the measuring mechanism 30, and a temperature control part 45 for controlling the heating and cooling mechanism 50, based on a measured value by the temperature sensor 40, to regulate the temperature of the measuring mechanism 30.



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* NOTICES *

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2.**** shows the word which can not be translated.
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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention]
This invention relates to the probe microscope which measures the shape of surface type etc. in the minute field of a sample.
[0002]
[Description of the Prior Art]
As everyone knows, samples, such as an electronic ingredient, are measured in a minute field, and scanning probe microscopes, such as an atomic force microscope and a scanning tunneling microscope, are known as equipment which performs observation of the shape of surface type of a sample, and measurement of a partial property. this scanning probe microscope is external as one of them, although various things are offered -- electromagnetism -- the scanning probe microscope which can measure a sample is offered without being influenced by a noise and the external noise (patent reference 1 reference).
This scanning probe microscope carried out the relative scan of the probe to the sample, and is equipped with the probe microscope unit which processes electrically the information acquired by this scan, and measures the detailed configuration on the front face of a sample, and the optical microscope unit for observing the optical image of a sample. Moreover, this probe microscope unit is expropriated in noise insulation and the box by which electromagnetic shielding was carried out, and is similarly arranged on the box about electric system currently arranged by this probe microscope unit, such as a sensor of a probe, and amplifier.
Moreover, it is not restricted to a scanning probe microscope given in the patent reference 1 mentioned above, but since the scanning probe microscope currently generally offered is sensitive to a sound noise from the outside, it is expropriated by the noise control case etc. in many cases.
[0003]
[Patent reference 1]
JP,5-40005,A (the paragraph number 0011-0019, drawing 2 [one to])
[0004]
[Problem(s) to be Solved by the Invention]
[0005]
The following technical problems are left behind under the above-mentioned conventional probe microscope. That is, under the conventional probe microscope, although electric system is expropriated by the inside a case, since this electric system is a heat source, the temperature of an inside a case will rise after powering on, and the temperature of the probe microscope unit itself will also rise. There was inconvenience which a probe microscope unit expands thermally, a drift produces by this, and an error produces in the measurement data of a sample. Therefore, for example, a temperature drift could not be effectively controlled only by coefficient of thermal expansion being low, although the ingredient which has low coefficient of thermal expansion, such as Invar, is used for the box etc. under the scanning probe

microscope given in the patent reference 1 so that the effect of this temperature drift may be reduced, and it was not enough.
Since especially the box used as a noise control case was unsuitable for diffusing internal heat, it was a thing which makes the temperature rise by the electric system of a probe microscope unit promote further. Since the installation environment of a probe microscope unit carried out temperature fluctuation even if it has eliminated the temperature of an inside a case to the box exterior, the temperature of the probe microscope unit itself was changed similarly, and there was a possibility that a drift might arise in the measurement data of a sample too.
[0006]
It is offering the probe microscope under which this invention was made in consideration of such a situation, that object's reduces thermal stability and drawing's can reduce the temperature drift of data.
[0007]
[Means for Solving the Problem]
In order to attain the above-mentioned object, this invention offers the following means.
The measurement device in which the probe microscope of this invention is a probe microscope which measures the shape of surface type and physical quantity of a device under test, and said measurement is performed where a probe is approached or contacted on the front face of said device under test, The temperature sensor which measures this measurement device or the temperature of the perimeter, and the heating cooler style which performs either [at least] heating or cooling to said measurement device, It is characterized by having the temperature control section which controls said heating cooler style based on the measured value of said temperature sensor, and adjusts the temperature of said measurement device.
[0008]
In case it sets in the probe microscope concerning this invention, a probe is approached or contacted on the surface of a device under test according to a measurement device and the shape of surface type and physical quantity of a device under test is measured, it is possible to measure maintaining own temperature of a measurement device at fixed predetermined temperature. Namely, it is measured by the temperature sensor and the temperature control section controls a heating cooler style based on the measured temperature, and by heating or cooling a measurement device, own temperature of a measurement device or the ambient temperature of a measurement device is maintaining it so that it may become fixed predetermined temperature. Thereby, thermal expansion for example, by temperature rise change etc. cannot produce a measurement device easily. Therefore, in case a device under test is measured, generating of the drift by the temperature change can be reduced and the dependability of a measurement result can be raised more.
[0009]
The probe microscope of this invention is equipped with the migration device to which said measurement device moves said probe relatively to said device under test in the probe microscope of above-mentioned this invention, and said temperature sensor and said heating cooler style are characterized by being arranged by said migration device.
Since the temperature sensor and the heating cooler style are arranged in the probe microscope concerning this invention by the migration device to which a probe is relatively moved to a device under test,
In case a device under test is measured, temperature management for the moving part which is the easiest to be influenced of a temperature drift can be performed. Since the temperature for the moving part which has the probe can be maintained at fixed predetermined temperature by this, in case a device under test is measured, generating of a drift can be reduced more effectively.
[0010]
In the probe microscope of above-mentioned this invention, said migration device is equipped with the three movable axial migration sections for said probe respectively corresponding to each direction of a three dimension, said temperature sensor and said heating cooler style are arranged for said every axial migration section, and the probe microscope of this invention is characterized by to control said each

heating cooler style so that said temperature control section serves as the same temperature as said each axial migration section.
In the probe microscope concerning this invention, since the temperature sensor and the heating cooler style are arranged in the three movable axial migration sections in the probe respectively corresponding to each direction of a three dimension, respectively, when they make a device under test move a probe in every direction, generating of a drift can be reduced certainly. Moreover, since the temperature control section controls each heating cooler style so that the temperature of each axial migration section becomes the same, the temperature gradient of each axial migration section of it is lost, and it can prevent the variation in the drift by the migration direction of a probe.
[0011]
The probe microscope of this invention has the voice coil motor which said migration device makes move said probe to either of above-mentioned this inventions in the probe microscope of a publication, and is characterized by said temperature control section driving said voice coil motor as said heating cooler style.
In the probe microscope concerning this invention, the temperature control section drives a voice coil motor, and is maintaining the temperature of a migration device at predetermined temperature. That is, the temperature control section is controlling the current value passed in a coil, and is performing temperature management of a migration device. Therefore, only by controlling the current value of a coil, since it can be made to function as a heating cooler style, even if it does not prepare a heating cooler style separately, temperature management of a migration device can be performed.
[0012]
The probe microscope of this invention is characterized by said temperature control section heating said measurement device beforehand by said heating cooler style before said measurement in a probe microscope given in either of above-mentioned this inventions.
In the probe microscope concerning this invention, since the temperature control section heats a measurement device beforehand by the heating cooler style before measurement, it becomes possible to set the temperature of a measurement device as the temperature at the time of stable actuation beforehand, for example. Thereby, the warming up of a measurement device is already thermally made at the time of measurement initiation, and early stabilization can be attained while being able to shorten time amount until it starts measurement.
[0013]
[Embodiment of the Invention]
Hereafter, the first operation gestalt concerning this invention is explained with reference to drawing 1 .
The probe microscope 1 shown in drawing 1 is an atomic force microscope (AFM) which measures the shape of surface type and physical quantity of Sample (device under test) A, and measures the shape of surface type in the minute field of Sample A with this operation gestalt. This probe microscope 1 is equipped with the probe microscope unit 10. This probe microscope unit 10 The measurement device 30 which measures in the condition of having made the head (probe) of a cantilever 20 approaching the front face of Sample A, The temperature sensor 40 which measures the temperature of this measurement device 30, and the heating cooler style 50 which performs either [at least] heating or cooling to the measurement device 30, It has the temperature control section 45 which controls the heating cooler style 50 based on the measured value of a temperature sensor 40, and adjusts the temperature of the measurement device 30.
[0014]
Moreover, the measurement device 30 is equipped with the migration device of X-Y stage 12 to which the head (probe) of a cantilever 20 is relatively moved to Sample A, Z stage 15, and scanner 17 grade, and the above-mentioned temperature sensor 40 and the heating cooler style 50 are considered as the configuration arranged by the scanner 17.
[0015]
the above-mentioned PUROPU microscope unit 10 is expropriated inside the covering 5 formed with the metal etc. while it is ****(ed) on the vibration control base 4 fixed to the vibration control member 3

which attenuates an oscillation with a floor -- having -- **** -- the noise insulation from the outside -- and electromagnetic shielding is carried out. This probe microscope unit 10 has the frame 11 formed in the cross-section mold of L characters with construction material, such as Invar, on the top face of the vibration control base 4, and movable above-mentioned X-Y stage 12 is attached in the top face of a frame 11 in the level surface (the XY direction). Moreover, the sample base 13 is attached on X-Y stage 12, and immobilization of Sample A of this sample base 13 is enabled on the top face. Namely, the sample A laid and fixed to the sample base 13 is made movable by X-Y stage 12 in the XY direction through the sample base 13.

[0016]

Moreover, above-mentioned Z stage 15 is attached in the upper part [of a frame 11], and X-Y stage 12 side through the Z stage mounting plate 14. This Z stage 15 has Z stage fixed part 15a and Z stage moving-part 15b, and Z stage moving-part 15b has the movable function in the direction of a vertical (Z direction) to X-Y stage 12. Moreover, the above-mentioned scanner 17 is attached in Z stage moving-part 15b through the scanner mounting plate 16, and the cantilever 20 which has a probe at a head is supported by the underside of a scanner 17. This cantilever 20 is formed with the construction material of silicon, silicon nitride, etc.

[0017]

The scanner 17 has the piezoelectric device (piezo-electric element) which is not illustrated inside, and is supporting the cantilever 20 movable minutely [the XYZ direction] in three dimension to Sample A. That is, a cantilever 20 is made minutely movable in the three directions of XYZ with the scanner 17 while it is made movable by Z stage moving-part 15b at a Z direction. That is, these scanners 17 and a cantilever 20 constitute a part of measurement device 30 which measures in the condition of having made the probe approaching the front face of Sample A. In addition, a frame 11, X-Y stage 12, the sample base 13, Z stage 15, the Z stage mounting plate 14, and scanner 17 grade are contained as what constitutes the measurement device 30.

[0018]

Moreover, on the scanner 17, it has the bending measuring instrument 25 which measures the amount of bending of a cantilever 20 inside. The detection value detected by this bending measuring instrument 25 is inputted into Z servo control section 26. Z servo control section 26 impresses an electrical potential difference to the piezoelectric device of a scanner 17 based on the inputted detection value, and is controlling the minute migration in the Z direction of a cantilever 20. It is controlled so that the amount of bending of a cantilever 20 becomes always fixed by this. Moreover, XY scan control section 27 is connected to the scanner 17, an electrical potential difference is impressed to the piezoelectric device of a scanner 17, and the minute migration in the XY direction of a cantilever 20 is controlled. It connects with the system controller 28 and these Z servo control section 26 and XY scan control section 27 are controlled synthetically. In addition, the temperature control section 45 is formed in the system controller 28.

[0019]

Furthermore, the temperature sensor 40 which measures own temperature of a scanner is attached in the scanner 17. This temperature sensor 40 consists of thermocouples, and has the function to send the measured temperature to the temperature control section 45. Here, the cooling section 47 which becomes the scanner mounting plate 16 from heat-conduction components, such as the heating unit 46 which consists of a heater etc., and a heat pipe, is laid underground. These heating units 46 and the cooling section 47 constitute the heating cooler style 50 which heats a scanner 17, cools and adjusts the temperature of a scanner 17 to predetermined temperature. Moreover, it connects with these heating units 46 and the cooling section 47, and the temperature control section 45 mentioned above has the function which controls a heating unit 46 and the cooling section 47 based on the measured value sent from the temperature sensor 40. Moreover, the temperature control section 45 controls a heating unit 46 and the cooling section 47 so that the temperature of a scanner 17 turns into predetermined temperature set up beforehand.

[0020]

As an electric unit 60 of the probe microscope unit 10, Z servo control section 26 and XY actuation control section 27 which were mentioned above are the upper part of a frame 11, and are arranged in the opposite hand of Z stage 15 in one. Moreover, various electrical parts which are not illustrated, such as amplifier and a relay, are attached in this electric unit 60.

[0021]

Thus, if the constituted probe microscope 1 turns on the electric power switch (un-illustrating) of the control panel of a system controller 28 first, the temperature of a scanner 17 will be displayed on the display (un-illustrating) of a control panel from a temperature sensor 40. Moreover, simultaneously, the temperature control section 45 begins to drive a heating unit 46 or the cooling section 47 so that a scanner 17 may be made into predetermined temperature. Under the present circumstances, after driving the probe microscope 1, the temperature of a scanner 17 rises, and the above-mentioned predetermined temperature is set as the terminal temperature of the field (stable zone) by which a temperature rise stops through fixed time amount, and temperature is stabilized. Thereby, the temperature control section 45 controls a heating unit 46 or the cooling section 47, heats or cools a scanner 17, and it performs a preheating so that it may become the temperature of a stable zone.

[0022]

Subsequently, after laying Sample A and fixing on the sample base 13, X-Y stage 12 and Z stage moving-part 15b are moved with the control panel of a system controller 28, and it positions so that a cantilever 20 may be located near the front face of the measurement field of Sample A. Subsequently, Z servo control section 26 and XY scan control section 27 are operated through a system controller 28, and minute migration of a scanner 17 and the cantilever 20 is carried out, for example, the probe of a cantilever 20 is brought close to the front face of the measurement field of Sample A to the distance of several nm. If a cantilever 20 is made to scan, a cantilever 20 will be bent by this condition according to the force between atoms between the front face of Sample A, and the probe of a cantilever 20, this amount of bending will be bent by it, and it will be measured by the measuring instrument 25 in it. Based on this detection value, Z servo control section 26 controls the minute migration to the Z direction of a cantilever 20 so that the amount of bending of a cantilever 20 becomes fixed. Thereby, a cantilever 20 has the fixed amount of bending, and since it can scan the minute field on Sample A, it can acquire easily the shape of surface type in the minute field of Sample A.

[0023]

Since the electric unit 60 has various electrical parts, such as Z servo control section 26, XY scan control section 27 and a coil, and amplifier, in the case of the measurement mentioned above here, the internal temperature of each electrical machinery component goes up, and heat is generated. It is going to be filled with this generated heat in covering 5, and it tends to carry out temperature up of the temperature of each component of the covering 5 interior and the probe microscope unit 10. However, since the scanner 17 is adjusted so that the temperature of the set-up request may be maintained by the temperature sensor 40, the heating cooler style 50, and the temperature control section 45, it cannot be easily influenced of the temperature change of the covering 5 interior. That is, since a scanner 17 maintains the always set-up temperature while resulting during measurement from before measurement, without being influenced by the surrounding temperature change, thermal expansion by the temperature change etc. cannot produce it easily, for example. Since the effect of a temperature drift is reduced by this in case Sample A is measured, the shape of surface type of the more exact sample A can be measured.

[0024]

Since it is arranged by the scanner 17 which carries out minute migration of the cantilever 20, the heating cooler style 50 is arranged by the scanner mounting plate 16 and especially the temperature sensor 40 carries out heating cooling of the direct scanner 17, in case it measures Sample A, it is managing the temperature for the moving part which is the easiest to be influenced of a temperature drift. Since the temperature of a cantilever 20 can be maintained at fixed temperature by this, generating of a temperature drift can be reduced more effectively. Since especially the scanner 17 contains the bending measuring instrument 25, the piezoelectric device which carries out minute migration of the

probe of a cantilever, it is desirable to carry out temperature control for the operational stability.
[0025]
Moreover, since the temperature control section 45 heats a scanner 17 beforehand by the heating cooler style 50 before measurement of Sample A, it becomes possible to set it as the terminal temperature of the stable zone of a scanner 17 beforehand. The warming up of a scanner 17 is already thermally made by this at the time of measurement initiation of Sample A, and early stabilization can be attained while being able to shorten time amount until it starts measurement. Furthermore, when a power source is switched on, the shape of surface type of Sample A can be measured immediately, without being influenced by the temperature drift.
[0026]
In this probe microscope 1, in case a cantilever 20 is made to approach the front face of Sample A and the shape of surface type of Sample A is measured, it is possible to measure maintaining at the temperature which asks for the temperature of a scanner 17. Thereby a scanner 17 can measure Sample A, without being influenced by the effect by the surrounding temperature change. Therefore, in case Sample A is measured, generating of the drift by the temperature change can be reduced and the dependability of the measurement result of Sample A can be raised more.
[0027]
Next, the second operation gestalt concerning this invention is explained with reference to drawing 2 . In this operation gestalt, about the same part as the component in the first operation gestalt, the same sign is attached and that explanation is omitted.
Although the migration device is equipped with the scanner which used the piezoelectric device and a different point of the second operation gestalt and the first operation gestalt considered it as the configuration which carries out minute migration of the cantilever by the piezoelectric device with the first operation gestalt, it is a point that the migration device 100 is equipped with three movable voice coil motors (axial migration section) for the probe of a cantilever respectively corresponding to each direction of a three dimension, with the second operation gestalt.
[0028]
The migration device 100 of this operation gestalt is equipped with the X-axis voice coil motor 110, the Y-axis voice coil motor 120, and the Z-axis voice coil motor 130. The Z-axis voice coil motor 130 has the motor core section 131 which consists of a permanent magnet fixed to the interior of casing 101. The needle 133 around which the coil 132 was wound has fitted loosely into the perimeter at this motor core section 131. This needle 133 is elastically supported by casing 101 by the membrane 134, and the end of the Z-axis spindle 135 which extended in the Z direction is attached in the end face. Moreover, the cantilever 20 is attached in the other end of the Z-axis spindle 135 through the bending measuring instrument 25.
[0029]
Moreover, the Z-axis spindle 135 is expropriated on the same axle inside the elastic cylinder-like cylinder 140 by which the end was fixed to casing 101. This elastic cylinder 140 has the supporter 141 fixed to casing 101, the elastic tubed part 142 which was connected with the supporter 141 and extended to the Z direction, and the inelastic tubed parts 143 and 144 which were connected with the elastic tubed part 142 and extended further to the Z direction, and, on the whole, is really formed.
[0030]
Here, the X-axis voice coil motor 110 and the Y-axis voice coil motor 120 are considered as the same configuration as the Z-axis voice coil motor 130 mentioned above, and have the X-axis spindle 115 and the Y-axis spindle (un-illustrating), respectively. The other end of these X-axes spindle 115 and a Y-axis spindle is connected with the inelastic tubed part 143 toward the X-axis and a Y-axis, respectively. Thereby, the coil 112 of the X-axis voice coil motor 110 and the coil 122 of the Y-axis voice coil motor 120 are made to pass and drive a current, and when turning and carrying out the variation rate of the X-axis spindle 115 and the Y-axis spindle to each shaft, the inelastic tubed part 143 displaces according to it. If the inelastic tubed part 143 displaces, the elastic cylinder 140 will rock near the boundary of a supporter 141 and the elastic tubed part 142 as the supporting point. Since this also rocks the Z-axis

spindle 135, a cantilever 20 is turned and moved in the XY direction. That is, the scan of a cantilever 20 in the XY direction is attained. Moreover, by changing the current value passed in the coil 132 of the Z-axis voice coil motor 130 based on the detection value detected with the bending measuring instrument 25, the migration to the Z direction of a cantilever 20 carries out the variation rate of the Z-axis spindle 135, and moves a cantilever 20. Thereby, a cantilever 20 is controlled so that distance with Sample A becomes fixed.

[0031]

Here, the temperature sensor 170 is attached in the motor core sections 111, 121, and 131 of each voice coil motors 110, 120, and 130 mentioned above, respectively, and the temperature of each voice coil motors 110 and 120 and 130 the very thing is measured. The temperature detected with this temperature sensor 170 is sent to the temperature control section 180. The temperature control section 180 has the function which passes and controls a predetermined current in each coil so that it may become the temperature of the request which set up the temperature of each voice coil motors 110, 120, and 130 based on this inputted temperature. That is, the temperature control section 180 controls the current value passed in each coils 112, 122, and 132, and is adjusting the temperature of each voice coil motors 110, 120, and 130. Under the present circumstances, the temperature control section 180 is controlling the current value of each coils 112, 122, and 132 so that the temperature of each voice coil motors 110, 120, and 130 turns into the same temperature. That is, let each coils 112, 122, and 132 be the heating cooler styles 190 which make a voice coil motor heat at least, respectively. In addition, the current passed in the coils 112, 122, and 132 of each voice coil motors 110, 120, and 130 is set as the maximum of the rated current.

[0032]

Thus, when it has the constituted migration device 100, before measuring Sample A, the temperature control section 180 controls the current value passed in each coils 112, 122, and 132 so that each voice coil motors 110, 120, and 130 become the terminal temperature of a stable zone mentioned above. Thereby, the temperature of each voice coil motors 110, 120, and 130 goes up, and preheating operation is carried out. Thus, early stabilization can be attained, while being able to shorten time amount until it starts measurement since the temperature of each voice coil motors 110, 120, and 130 is already stable at the event of measurement initiation if each voice coil motors 110, 120, and 130 are controlled to terminal temperature. Moreover, since the temperature of each voice coil motors 110, 120, and 130 is stable, the temperature change that the temperature of each voice coil motors 110, 120, and 130 rises with time amount can be prevented, and the effect of a temperature drift can be reduced.

[0033]

Moreover, since the temperature control section 180 controls the temperature of each voice coil motors 110, 120, and 130 to become the same temperature while it is controllable in the temperature of each voice coil motors 110, 120, and 130, it can prevent the variation in the drift by the migration direction of a cantilever 21.

Furthermore, since it can be made to function on coils 112, 122, and 132 as a heating cooler style 190 only by passing the maximum current of rated value before measurement of Sample A, even if it does not prepare a heating cooler style separately, temperature management of each voice coil motors 110, 120, and 130 can be performed.

[0034]

In addition, it is not limited to the above-mentioned operation gestalt, the range which does not deviate from the meaning of this invention sets, and the technical range of this invention can add various modification.

With the operation gestalt concerning this invention, although the probe microscope was used as the atomic force microscope which a cantilever is made to approach on the surface of a sample, and measures the shape of surface type of a sample, it may not be restricted to this, but may contact a cantilever in a sample, and may measure the physical quantity of a sample. Moreover, in the first operation gestalt, although considered as the configuration which attaches a temperature sensor in a scanner and controls the temperature of a scanner, it is not restricted to this and you may attach in the Z

stage which otherwise constitutes a migration device. Furthermore, you may attach in the member which constitutes measurement devices, such as this not only migration device but a frame.
[0035]
That is, what is necessary is just to constitute at least one component as a temperature administration object element among the components of a measurement device. In this case, as a component which is most influenced of temperature fluctuation and causes a temperature drift, you may specify by the simulation and system test at the time of a design.
Moreover, a temperature sensor is attached in a scanner, and although considered as the configuration which measures the temperature of a scanner directly, it does not matter as a configuration which measures the temperature around a measurement device. For example, the internal temperature of covering, the temperature of covering, or electric unit temperature may be measured.
Furthermore, although considered as the configuration which attached the heating cooler style in the scanner mounting plate, it is not restricted to this but heating and cooling should just be constituted possible to the scanner. For example, a heating cooler style may be arranged in a Z stage mounting plate, and a scanner may be heated and cooled.
Moreover, although the preheating by heating was performed, when it has sufficient cooling functions, such as a heat pipe, it is not necessary to perform a preheating. For example, when carrying out movable [of the probe microscope], the temperature rise of a probe microscope can be suppressed by the cooling function, and it can measure in the state of the suitable temperature according to an installation environment by carrying out cooling control to fixed temperature.
[0036]
[Effect of the Invention]
The effectiveness taken below can be done so in the probe microscope of this invention. That is, in case a probe is approached or contacted on the surface of a device under test according to a measurement device and the shape of surface type and physical quantity of a device under test is measured, it is possible to measure maintaining own temperature of a measurement device at predetermined temperature. Thereby, in case a measurement device measures a device under test, it can reduce generating of the drift by the temperature change, and can raise the dependability of a measurement result more.
[Brief Description of the Drawings]
[Drawing 1] It is the block diagram showing the probe microscope concerning the first operation gestalt of this invention.
[Drawing 2] It is the sectional view showing the voice coil motor used for the probe microscope concerning the second operation gestalt of this invention.
[Description of Notations]
A Device under test
1 Probe Microscope
12 X-Y Stage (Migration Device)
15 Z Stage (Migration Device)
17 Scanner (Migration Device)
30 Measurement Device
40,170 Temperature sensor
45,180 Temperature control section
50,190 Heating cooler style
100 Migration Device
110, 120, 130 Voice coil motor (axial migration section)

[Translation done.]